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NATURAL REFORESTATION AFTER LOGGING ON AFOGNAK ISLAND

by

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ABSTRACT

Observations of natural reforestation on a 100-acre cutting unit 25 years after logging showed that some areas were still dominated by grass-herbaceous vegetation and that growth of Sitka spruce seedlings was slow. This competition probably is slowing growth of trees and preventing natural restocking of spruce. If conditions described prove to be typical, measures to control competition will be necessary to insure adequate reforestation after logging on Afognak Island, Alaska.

Keywords: Natural regeneration (forests), reforestation, Sitka spruce, logging.

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Afognak Island, Alaska (latitude 58°15' N., longitude 152°30' W.), lies near the extreme western limit of Sitka spruce.[1/] To the west, the Alaska Peninsula and Aleutian Islands are essentially treeless.

Sitka spruce is the only conifer on Afognak Island and, although relatively new to the island, is gradually advancing west and south, invading open grass-herbaceous vegetation-covered land. Studies on nearby Kodiak Island have shown the rate of this forest advance to be about 1 mile per century (Griggs 1934).

These primary stands of Sitka spruce together with the extensive volcanic ash layer laid down by the eruptions in the Katmai region in 1912 (Griggs 1922, Martin 1913, Curtis 1955) set Afognak and the adjacent islands of Kodiak and Shuyak apart as a unique forested area.

Afognak Island, with a land area of 717 square miles, is part of the Chugach National Forest. Established in 1892 as the Afognak Forest and Fish Culture Reserve, the island was the first area included in what has come to be the National Forest System. The Sitka spruce forests of Afognak Island now include 230,000 acres of commercial forest land with a net volume of 5.3 billion board feet (Scribner) (Institute of Northern Forestry 1967).

To date, only a limited amount of timber has been cut on Afognak Island. During World War II, a few cuttings were made at Kazakof Bay and Afognak Bay to supply logs for a local sawmill operated by the U.S. Army, with lumber used in Kodiak and the Aleutians. Later, a small area was logged along Raspberry Strait to supply a local mill. This mill was destroyed by a tidal wave in 1964, and since then, no timber has been harvested on the island. Because of this limited experience with timber cutting, little is known about reforestation of Sitka spruce on Afognak Island.

In 1968 we investigated natural reforestation on a 100-acre World War II cutting unit at Kazakof Bay. The unit is on hilly topography, and soils are well drained except for small bottomland areas which are swampy or contain small ponds. In general, vegetation type is similar to that described as 6-SP (growing on soils of the Kodiak series) by Rieger and Wunderlich (1960). The unit was essentially clearcut in 1943 and 1944, with residual trees left scattered over the area (fig. 1). Logs were high-lead yarded and skidded to tidewater by cable or crawler tractor.

METHODS

During the summer of 1968, 36 circular 4-milacre plots (7.45-foot radius) were located at 2-chain (132-foot) intervals along three lines crossing the cutting unit (fig. 2). Three plots situated in swampy conditions were discarded.

[1] Scientific names of plants mentioned are shown on page 10

Figure 1.—Twenty-five years after logging, the cutting unit at Kazakof Bay still had an open appearance, with residual trees and advanced seedlings scattered throughout. (Photo taken May 1969.)

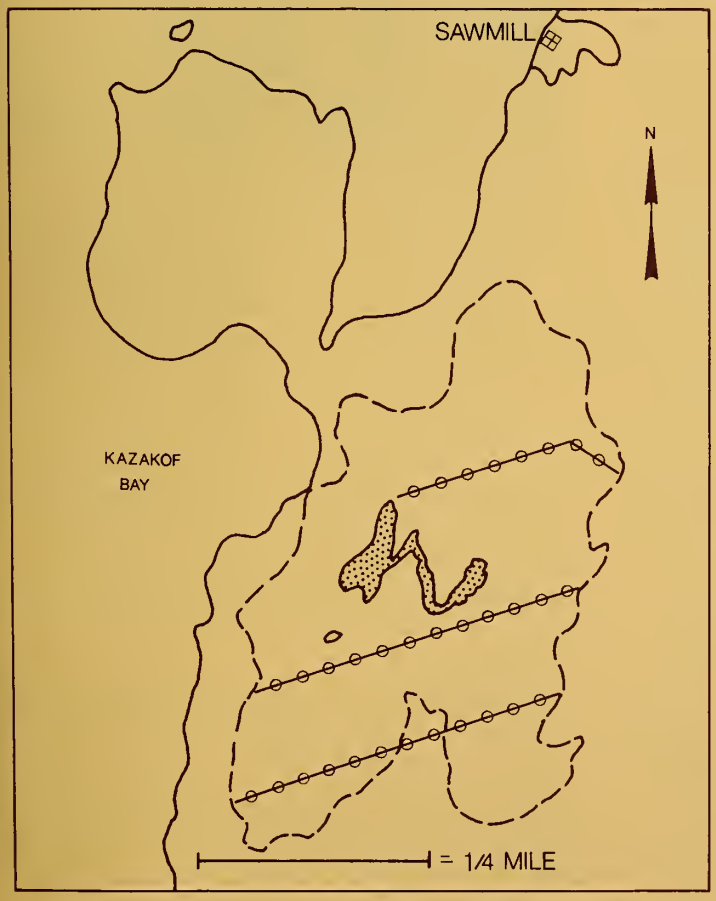

Figure 2.—Location of 4-milacre regeneration plots—World War II cutting, Kazakof Bay, Afognak Island, Alaska.

The total number of spruce seedlings on each plot was recorded. Total height and 3-year leader growth of up to three of the largest spruce on each plot were measured, and the seedbed situation of each spruce was recorded. These dominant spruce were then cut at the root collar, and annual rings were counted to determine age. Seedlings over 25 years old at root collar were classed as "advanced" seedlings, having been established before logging; and those younger, as "subsequent" seedlings, having originated from seed after logging. Other information recorded was: slope, drainage, aspect, percentage of each plot occupied by plant species or surface condition, depth of organic accumulation above volcanic ash, and depth of volcanic ash.

In 1969, nine spruce trees, which originated in the understory of the former stand and were undamaged by logging, were cut and sectioned to determine growth rate. These trees were selected from vigorous, apparently normal trees to supplement data on growth of seedlings previously measured on sample plots. Their heights ranged from 29 to 43 feet.

RESULTS AND DISCUSSION

Seventy-three percent of the plots were stocked with at least one spruce, and tree density averaged 1,740 stems per acre. This level of stocking would be considered adequate by Regional standards[2] if the survey had been made from 5 to 10 years after logging and if all seedlings were producing good growth. However, the cutting unit still had an open appearance 25 years after logging, with many areas dominated by brush, grass, and herbaceous vegetation (fig. 3).

Figure 3.—Twenty-five years after logging, many portions of the cutting unit at Kazakof Bay were covered with brush. Salmonberry is the most prominent species visible in the foreground of this photo taken in May 1969.

This level of restocking is far below what one would expect on a cutting of similar age in southeast Alaska. For example, on a mile-square cutting unit in Maybeso Valley 8 years after logging, 83

[2] Region 10 stocking standards, based on the percentage of 4-milacre plots containing at least one healthy and vigorous seedling 6 inches or more in height and free to grow, are: desired stocking, 70 percent or more; satisfactory stocking, 40-69 percent; poor or unsatisfactory stocking, 10-39 percent; nonstocked, less than 10 percent.

percent of 4-milacre plots were stocked and stand density averaged 4,872 seedlings per acre (Harris 1967).

At Kazakof Bay, growth rate of dominant spruce seedlings was slow (fig. 4), and only 30 percent of the plots contained a spruce seedling at least 4.5 feet tall. Only 21 percent of the plots contained a seedling growing at least 6 inches annually; 48 percent, 4 inches; and 70 percent, 2 inches. Slow-growing seedlings may eventually mature, but it is doubtful that many of those overtopped by dense competing vegetation or growing slowly for other reasons will develop into merchantable trees at the anticipated stand rotation age of 110 years.[3/] (fig. 5).

Some plots contained seedlings established both before and after logging. Subsequent spruce were found on 67 percent of plots; advanced spruce, on 15 percent. Based on the three largest seedlings per plot, dominant subsequent seedlings became established on the cutting over an 18-year period after logging, but none thereafter (fig. 6). Sixty-six percent of the subsequent seedlings examined grew on rotten wood, upturned roots, or alongside stumps; 20 percent, on mixed organic-ash seedbeds; 9 percent, on moss; and 5 percent on shallow organic soil underlain by rock. Seedlings which were located on ash grew best, whereas seedlings which were located on rotten logs, elevated roots, stumps, or shallow moss-covered soil over rock grew more slowly.

Competition from brush, grass, and herbs appeared to be the most important factor influencing distribution and growth of seedlings (fig. 7). Nonstocked plots contained a higher proportion of fireweed, devil's club, and salmonberry than did stocked plots, but average height of these competing plant species differed little between stocked and nonstocked plots (table 1).

Average depth of volcanic ash and surface organic material differed little between stocked and nonstocked plots--on stocked plots, volcanic ash averaged 5.2 inches in depth; on nonstocked plots, 4.9 inches. Surface organic matter which had accumulated since the ashfall of 1912 averaged 4.0 inches on stocked plots and 3.7 inches on nonstocked plots.

The most prominent trees on the cutting unit were spruce that had escaped logging. Such trees were often growing at the rate of a foot or more annually, although early growth was slow (fig. 8).

Stem analysis of nine residual spruce, which were cut and sectioned in 1969, showed that height growth was not affected by the 1912 deposition of volcanic ash. Rate

[3]W. R. Overdorff, John Galea, Lyle Jack, and others. Timber management plan, Chugach Working Circle, Alaska Region, 1967-1976. Mimeogr. Chugach National Forest, Anchorage, Alaska. 1967.

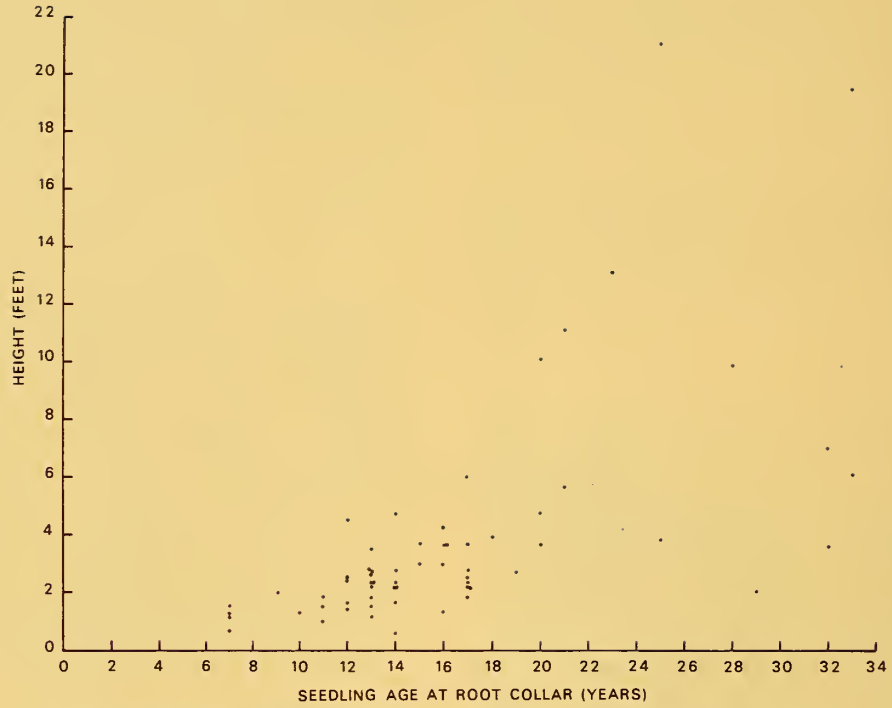

Figure 4.—Height and age of dominant spruce in 1968, 25 years after logging—World War II cutting, Kazakof Bay, Afognak Island.

Figure 5.—Many spruce seedlings such as this one at Kazakof Bay are growing slowly. The observer is standing in dense fireweed-grass-salmonberry cover which offers severe competition for Sitka spruce. (Photographed July 1968.)

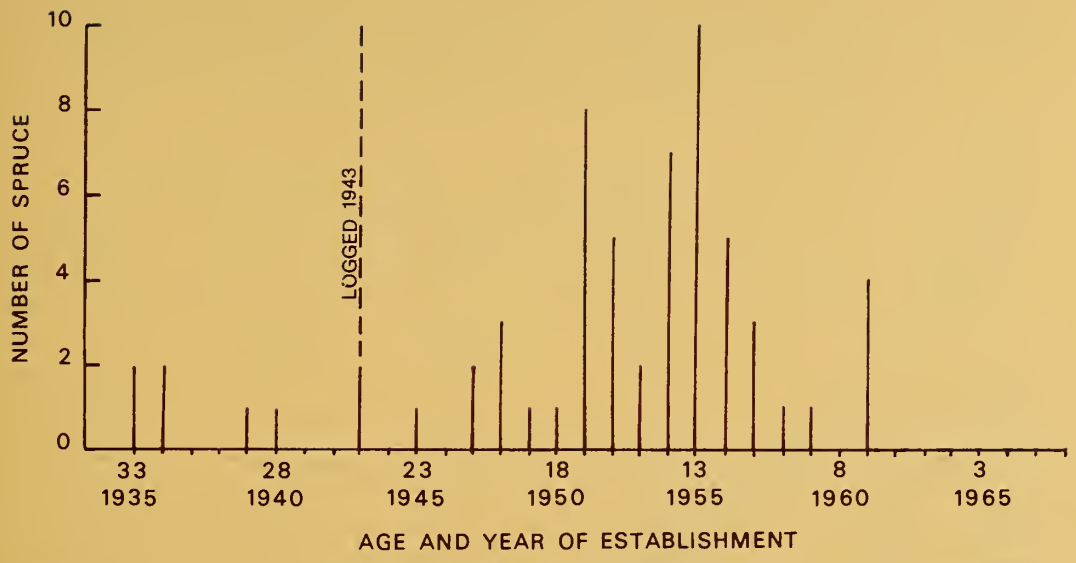

Figure 6.—Age distribution of 64 dominant spruce on 4-milacre plots in 1968, 25 years after logging—World War II cutting, Kazakof Bay, Afognak Island.

Figure 7.—Dense growth of fireweed, grass, salmonberry, and devil's club offers severe competition to establishment of Sitka spruce at Kazakof Bay. (Photographed July 1968.)

Table 1.--*Percent and height of ground cover on stocked and nonstocked 4-milacre reforestation plots, Kazakof Bay, Afognak Island, Alaska, July 1968*

Ground cover	Stocked plots		Nonstocked plots	
	Plot occupancy	Average height	Plot occupancy	Average height
	Percent	*Inches*	*Percent*	*Inches*
Grass	24	35	13	40
Fireweed	16	52	40	54
Devil's club	10	41	18	43
Salmonberry	8	38	14	35
Moss	17	--	6	--
Early blueberry	9	--	0	--
Alder	2	--	5	--
Fern	4	--	2	--
Spruce	7	--	0	--
Rotten wood	2	--	2	--
Other	1	--	0	--

Figure 8.--In July 1969, this residual spruce was 43 feet tall and 88 years old at a 1-foot stump. Annual growth during the last 5 years averaged 1 foot. Early growth was slow.

of height growth increased after overstory trees were harvested (fig. 9).

There were few signs of recent animal damage to spruce seedlings, although 10 percent of seedlings examined showed some evidence of past browsing. Varying hares (*Lepus americanus*) were introduced on Afognak Island in 1934 and are said to have reached a population peak about 1946. Populations then declined but increased again between 1954 and 1957.[4/] Population levels apparently have been low during recent years. Vincent reported that spruce needles are an

[4]Robert Vincent. Notes on geology, history, land mammals, birds, and plants of Kitoi Bay, 67 p., 1965. (Unpublished paper on file at Forestry Sciences Laboratory, Juneau, Alaska.)

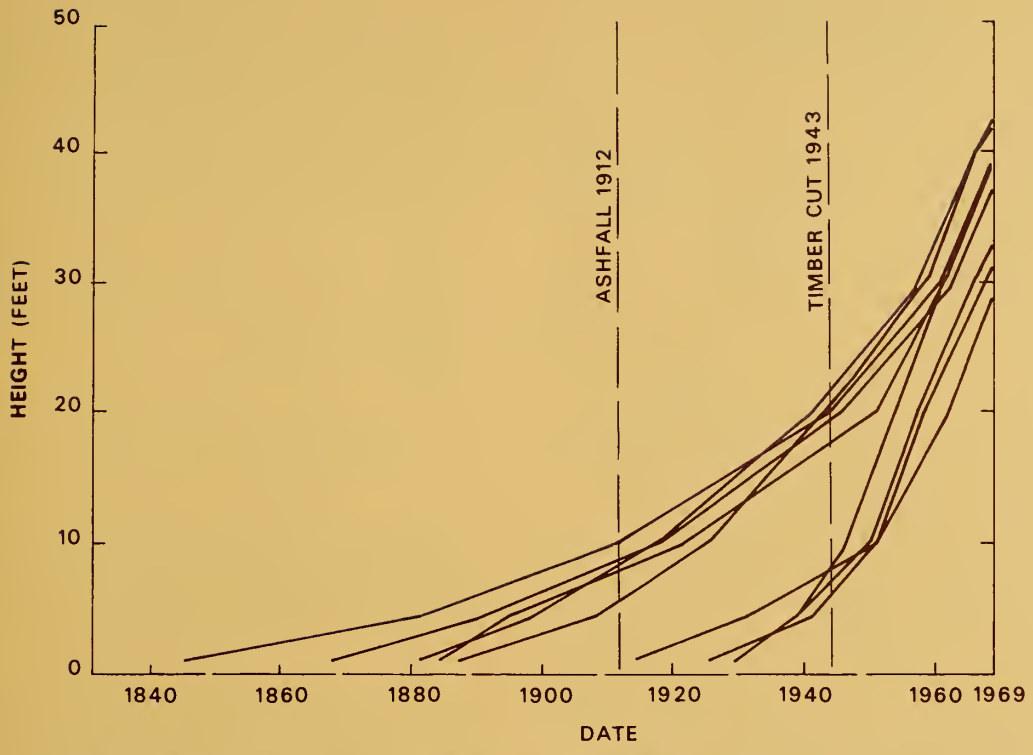

Figure 9.—Height development of nine residual spruce sectioned in 1969 had been unaffected by ashfall in 1912. Rate of height growth increased after the overstory was removed in 1943 and in 1969 was similar to that of the better growing subsequent and advanced seedlings.

important part of a hare's diet. It is possible that hares may have caused severe losses of seedlings during the population peak of 1946, but no evidence of such losses would be apparent today.

Roosevelt elk (*Cervus canadensis*) were introduced on Afognak Island in 1928 and have established sizable herds (Batchelor 1965, Troyer 1960). Although elk tracks were numerous on the cutting unit, no damage to seedlings was apparent.

Sitka black-tailed deer (*Odocoileus hemionus sitkensis*) were introduced to Kodiak Island in 1924 and have spread to Afognak Island. Deer doubtless frequent the study area at times, but no seedling damage was observed.

Detailed records of spruce seed production on Afognak Island are lacking. Large crops of cones are known to occur, but seed quality or crop periodicity is not known. The cutting unit at Kazakof Bay is small and contains some residual seed trees, so during good seed years an adequate source of seed should be available.

CONCLUSIONS

Observations of natural reforestation at Kazakof Bay 25 years after logging showed that parts of the cutting unit were still dominated by grass-herbaceous vegetation and that many seedlings were growing slowly. Stocking density would be considered adequate if all seedlings were producing good growth, but the slow growth of many seedlings may make reforestation inadequate to meet management objectives. Dense grass-herbaceous vegetation appears to be an important factor limiting natural reforestation and is apparently slowing or preventing further natural restocking of spruce. Volcanic ash does not appear to have contributed to slow reforestation--seedlings grew best on volcanic ash seedbeds.

If conditions noted here prove to be typical, treatment to control competing vegetation, together with planting or seeding of spruce, will be necessary to regenerate stands promptly after timber harvesting. Competing vegetation might be controlled by surface scarification or by application of approved selective herbicides where environmental safety is assured.

Shelterwood cutting may prove to be an appropriate silvicultural system for use on Afognak Island. Interest is being shown in the shelterwood system because of its potential for reducing plant competition for tree regeneration in second-growth western hemlock-Sitka spruce stands in Oregon (Ruth 1965). Some modification of the system might be required for use in primary stands of Sitka spruce. Until more experience with reforestation is available, forest managers should proceed cautiously with plans for large-scale timber harvesting on Afognak Island.

COMMON AND SCIENTIFIC NAMES OF PLANTS MENTIONED

Sitka spruce — *Picea sitchensis* (Bong.) Carr.
Fireweed — *Epilobium angustifolium* L.
Devil's club — *Oplopanax horridum* (J. E. Sm.) Mig.
Salmonberry — *Rubus spectabilis* (Pursh)
Alder — *Alnus sinuata* (Reg.) Rydg.
Moss — *Musci* (class)
Fern — *Athyrium filixfemina** (L.) Roth
Grass — *Calamagrostis canadensis** (Michx.) Beauv.
Early blueberry — *Vaccinium ovalifolium* Sm.

*Most common species noted. Others may be represented in association but are less common.

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